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Agricultural Memorandum No 508

Estimation of mean monthly temperatures - L P SMITH

An exercise was carried out to find the degree of error when the mean monthly temperature (for a current year) at a site was estimated from the records of neighbouring stations.

Two sets of three MWR reporting stations were chosen:

1. Lincoln and Cranwell were used to estimate for Waddington (10 km from Lincoln and 15 km from Cranwell) in relatively flat country.

2. Huddersfield (Oakes) and Pontefract were used to estimate for Lister Park Bradford (25 km from Huddersfield and 35 km from Pontefract) in relatively hilly country.

The average mean monthly temperatures at Waddington and Bradford were assumed to differ from that of the neighbourhood stations by reason only of their difference in height above MSL. The correction adopted for height was 0.55°C per 100 m and 3°F per 1000 ft.

For the Lincolnshire stations the results were:

	MSL averages (1931-60)			Averages. Waddington (68 m)		
	Lincoln (7 m)	Cranwell (62 m)	Mean	Estimated	Actual	Error
Jan	3.34	3.34	3.34	3.0	3.0	0
Feb	3.44	3.84	3.64	3.3	3.6	-0.3
Mar	5.94	5.84	5.89	5.5	5.6	-0.1
Apr	8.14	8.54	8.34	8.0	8.3	-0.3
May	11.54	11.44	11.49	11.1	11.2	-0.1
Jun	13.94	14.64	14.29	13.9	14.3	-0.4
Jul	16.34	16.64	16.49	16.1	16.3	-0.2
Aug	15.94	16.34	16.14	15.8	16.1	-0.3
Sep	13.74	14.14	13.94	13.6	13.8	-0.2
Oct	9.94	10.34	10.14	9.8	10.0	-0.2
Nov	6.24	6.74	6.49	6.1	6.4	-0.3
Dec	4.14	4.54	4.34	4.0	4.2	-0.2

The mean error is 0.2°C but it is noteworthy that Cranwell is a better guide to Waddington than Lincoln, indicating that similarity of site is more important than proximity.

Using these estimated averages, it is now possible to make estimates for each month of 1971, assuming that the deviation from average at Waddington is the mean of the deviations at Lincoln and Cranwell; this mean deviation was then applied to the estimated average.

1971	Deviations from average		Mean	Mean monthly temperature. Waddington		
	Lincoln	Cranwell		Estimated	Actual	Error
Jan	+1.0	+0.7	+ 0.9	3.9	3.9	0
Feb	+0.5	+0.8	+ 0.6	3.9	4.5	-0.6
Mar	-0.9	-0.8	- 0.8	4.6	4.9	-0.3
Apr	-0.8	-1.1	- 0.9	7.1	7.3	-0.2
May	-0.6	-0.2	- 0.4	10.7	11.1	-0.4
Jun	-2.1	-2.4	- 2.2	11.7	11.9	-0.2
Jul	0.0	+0.4	+ 0.2	16.3	17.1	-0.8
Aug	-0.4	-0.5	- 0.4	15.3	15.6	-0.3
Sep	-0.2	+0.3	0	13.6	14.5	-0.9
Oct	+1.4	+1.1	+ 1.3	11.1	11.5	-0.4
Nov	-1.2	-0.9	- 1.1	5.0	5.7	-0.7
Dec	+1.6	+1.4	+ 1.5	5.5	6.1	-0.6

(Note: To avoid using hundredths for the mean, it was biased to the nearest station, Lincoln)

The mean monthly error is 0.45°C, at least half of which is due to the under estimate of the long-term averages. If the Waddington average had been taken to be the same as Cranwell, the errors would have been

-0.1, -0.3, -0.2, -0.1, -0.4, +0.1, -0.6, 0.0, -0.6, -0.3, -0.3, and -0.4

The results for the West Riding stations are:

	MSL Averages (1931-60)		Mean	Averages. Bradford (135 m)		
	Huddersfield (235 m)	Pontefract (78 m)		Estimated	Actual	Error
Jan	3.99	3.53	3.76	3.0	2.9	+0.1
Feb	4.19	3.93	4.06	3.3	3.1	+0.2
Mar	6.19	5.83	6.01	5.3	5.0	+0.3
Apr	8.79	8.53	8.66	7.9	7.7	+0.2
May	11.79	11.33	11.56	10.8	10.6	+0.2
Jun	14.89	14.43	14.66	13.9	13.8	+0.1
Jul	16.69	16.33	16.51	15.8	15.6	+0.2
Aug	16.49	15.93	16.21	15.5	15.2	+0.3
Sep	14.19	13.93	14.06	13.3	13.1	+0.2
Oct	10.79	10.33	10.56	9.8	9.5	+0.3
Nov	7.29	6.93	7.11	6.4	6.2	+0.2
Dec	5.29	4.83	5.06	4.3	4.2	+0.1

A mean error of 0.2°C, of the same order as in Lincolnshire, which is possibly due to the "heat island" of the city of Bradford.

Proceeding as before, the monthly estimates were:

1971	Deviations from average		Mean	Mean monthly temperature. Bradford		
	Huddersfield	Pontefract		Estimated	Actual	Error
Jan	+1.4	+1.0	+1.2	4.2	3.9	+0.3
Feb	+1.2	+1.1	+1.2	4.5	4.5	0
Mar	-0.4	-0.1	-0.3	5.0	4.9	+0.1
Apr	-0.5	-0.8	-0.6	7.3	7.0	+0.3
May	+0.4	+0.3	+0.4	11.2	10.9	+0.3
Jun	-2.6	-2.1	-2.4	11.5	11.5	0
Jul	+1.3	+0.8	+1.1	16.9	16.3	+0.6
Aug	-0.5	-0.4	-0.5	15.0	14.7	+0.3
Sep	+0.8	+0.6	+0.7	14.0	13.7	+0.3
Oct	+1.4	+1.3	+1.4	11.2	10.7	+0.5
Nov	-0.7	-0.6	-0.7	5.7	5.6	+0.1
Dec	+2.1	+2.3	+2.2	6.5	6.3	+0.2

The mean error is 0.25°C, much of which is due to the error in the estimate of the average.

These limited trials suggest that mean temperature estimation by this method leads to results which may attain an acceptable accuracy.

Any comments or suggestions on this paper should be referred to the author.

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